Ch 7 - Language of Chemistry

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Chemical Formulas

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H_2O H_2O_2

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	H_2O	H_2O_2
1 mole :	2 atoms H : 1 atom O	2 atoms H : 2 atoms O

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1 molec :	2 atoms H : 1 atom O	2 atoms H : 2 atoms O
2 molec :	4 " : 2 " O	4 " : 4 atoms O
6×10^{23} molec		

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Chemical Formulas

	H_2O	H_2O_2
1 molec :	2 atoms H : 1 atom O	2 atoms H : 2 atoms O
2 molec :	4 " : 2 " O	4 " " : 4 atoms O
6×10^{23} molec	1.2×10^{24} " : 6×10^{23} " O	1.2×10^{24} atoms H : 1.2×10^{24} atoms O

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Chemical Formulas

	H_2O	H_2O_2
1 molec :	2 atoms H : 1 atom O	2 atoms H : 2 atoms O
2 molec :	4 " : 2 " O	4 " " : 4 atoms O
6×10^{23} molec	1.2×10^{24} " : 6×10^{23} " O	1.2×10^{24} " H : 1.2×10^{24} atoms O
1 mol	2 mol H 1 mol O	2 mol H : 2 mol O

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Chemical Formulas

	H_2O	H_2O_2
1 molec :	2 atoms H : 1 atom O	2 atoms H : 2 atoms O
2 molec :	4 " : 2 " O	4 " " : 4 atoms O
6×10^{23} molec	1.2×10^{24} " : 6×10^{23} " O	1.2×10^{24} atoms H : 1.2×10^{24} atoms O
1 mol	2 mol H : 1 mol O	2 mol H : 2 mol O

Subscripts mean atoms when molecules, and moles when you have a mol of comp

Ionic Comp Formulas

Ionic Comp Formulas → Ions combine so Net charge = 0

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F^- MnO_4^- SO_3^{2-}

K^+

Cr^{2+}

Al^{3+}

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF		
Cr^{2+}			
Al^{3+}			

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Ca^{2+}			
Al^{3+}			

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2		
Al^{3+}			

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2		
Al^{3+}			

	Cr^{2+}	MnO_4^-
	~~$Cr(MnO_4)_2$~~	$Cr_2Mn_2O_8$

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2		
Al^{3+}			

Cr^{2+} MnO_4^-

~~Cr_2MnO_4~~ ~~$CrMn_2O_8$~~

$Cr(MnO_4)_2$

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2	$Cr(MnO_4)_2$	$CrSO_3$
Al^{3+}			

Cr^{2+} MnO_4^-

~~Cr_2MnO_4~~ ~~$CrMn_2O_8$~~

$Cr(MnO_4)_2$ ☺

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2	$Cr(MnO_4)_2$	$CrSO_3$
Al^{3+}	AlF_3		

Cr^{2+} MnO_4^-

~~Cr_2MnO_4~~ ~~$CrMn_2O_8$~~

$Cr(MnO_4)_2$ ☺

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}	Al^{3+}	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3		
Cr^{2+}	CrF_2	$Cr(MnO_4)_2$	$CrSO_3$		
Al^{3+}	AlF_3	$Al(MnO_4)_3$			

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}	Al^{3+}	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3		
Cr^{2+}	CrF_2	$Cr(MnO_4)_2$	$CrSO_3$	Al_2	
Al^{3+}	AlF_3	$Al(MnO_4)_3$			

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2	$Cr(MnO_4)_2$	$CrSO_3$
Al^{3+}	AlF_3	$Al(MnO_4)_3$	$Al_2(SO_3)_3$

$Al_2(SO_3)_3$

Ionic Comp Formulas → Ions combine so Net charge = 0

	F^-	MnO_4^-	SO_3^{2-}
K^+	KF	$KMnO_4$	K_2SO_3
Cr^{2+}	CrF_2	$Cr(MnO_4)_2$	$CrSO_3$
Al^{3+}	AlF_3	$Al(MnO_4)_3$	$Al_2(SO_3)_3$

$Al_2(SO_3)_3$

Criss Cross Method

Naming Ionic Comps

Naming Ionic Comps

NaCl sodium chloride

Naming Ionic Comps

NaCl sodium chloride

2 steps

Naming Ionic Comps

NaCl sodium chloride

2 steps
1. Name cation

Naming Ionic Comps

NaCl sodium chloride

2 steps
1. Name cation
2. Name anion

Naming Ionic Cmps

$NaCl$ sodium chloride

K_2SO_3

BaF_2

SnI_2

$Fe_2(SO_4)_3$

2 steps
1. Name cation
2. Name anion

Naming Ionic Comps

$NaCl$ sodium chloride

K_2SO_3 potassium sulfite

BaF_2

SnI_2

$Fe_2(SO_4)_3$

2 steps
1. Name cation
2. Name anion

Naming Ionic Comps

$NaCl$ sodium chloride

K_2SO_3 potassium sulfite

BaF_2 Barium fluoride

SnI_2

$Fe_2(SO_4)_3$

2 steps
1. Name cation
2. Name anion

Naming Ionic Comps

$NaCl$ sodium chloride

K_2SO_3 potassium sulfite

BaF_2 Barium fluoride

SnI_2 tin(II) iodide
stannous iodide

$Fe_2(SO_4)_3$

2 steps
1. Name cation
2. Name anion

Naming Ionic Comps

$NaCl$ sodium chloride

K_2SO_3 potassium sulfite

BaF_2 Barium fluoride

SnI_2 { tin(II) iodide → stock system
stannous iodide → olde system

$Fe_2(SO_4)_3$

2 steps
1. Name cation
2. Name anion

Naming Ionic Comps

$NaCl$ sodium chloride

K_2SO_3 potassium sulfite

BaF_2 Barium fluoride

SnI_2 { tin(II) iodide → stock system
Stannous iodide → olde system

$Fe_2(SO_4)_3$ Iron(III) sulfate
or
Ferric Sulfate

2 steps
1. Name cation
2. Name anion

Naming Covalent Compds

Naming Covalent Compds

CO_2

CO

As_2O_5

Naming Covalent Compds
(only nonmetals)

CO_2 Carbon dioxide

CO

As_2O_5

Naming Covalent Compds
(only nonmetals)

CO_2 Carbon dioxide

CO Carbon monoxide

As_2O_5

Naming Covalent Compds
(only nonmetals)

CO_2 Carbon dioxide

CO Carbon monoxide

As_2O_5 diarsenic pentoxide

Binary Naming Covalent Compds (only nonmetals)

Step 1: name 1st element
give numerical prefix
if more than 1

CO_2 Carbon dioxide

CO Carbon monoxide

As_2O_5 diarsenic pentoxide

Binary Naming Covalent Compds (only nonmetals)

CO_2 Carbon dioxide

CO Carbon monoxide

As_2O_5 diarsenic pentoxide

Step 1: name 1st element
give numeric prefix
if more than 1

Step 2: name 2nd element
giving it numeric prefix
& -ide suffix

Binary Naming Covalent Compds (only nonmetals)

CO_2 Carbon dioxide

CO Carbon monoxide

As_2O_5 diarsenic pentoxide

Step 1: name 1st element
give numeric prefix
if more than 1

Step 2: name 2nd element
giving it numeric prefix
& -ide suffix

prefixes

1 - mono
2 - di
3 - tri
4 - tetra-
5 - penta
6 - hexa-
7 - hepta-
8 - octa-
9 - nona-
10 - deca-

Binary Naming Covalent Compds (only nonmetals)

CO_2 Carbon dioxide

CO Carbon monoxide

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Step 1: name 1st element
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prefixes

1 - mono
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9 - nona-
10 - deca-

Naming Acids (start w/ H)

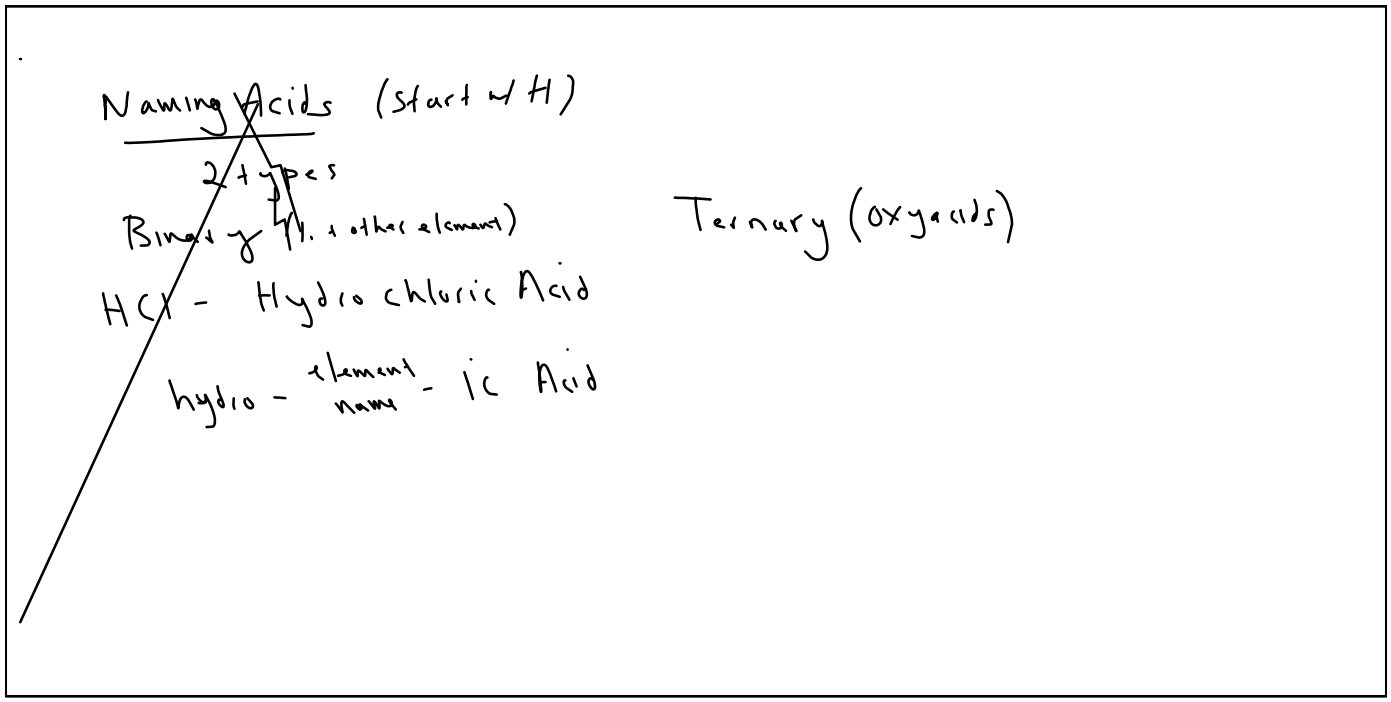
Naming Acids (start w/ H)

2 types

Binary

HCl - Hydrochloric Acid

Ternary (oxyacids)


Naming Acids (start w/ H)
2 types
Binary (H + other element)
Ternary (oxyacids)
HCl - Hydro chloric Acid
hydro - element name - ic Acid

Naming Acids (start w/ H)

2 types

Binary (H + other element)

Ternary (oxyacids)

HCl - Hydrochloric Acid

hydro - element name - ic Acid

HF -

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydrofluoric Acid

Ternary (oxyacids)

Naming Acids (start w/ H)

2 types

Binary (H + other element) Ternary (oxyacids)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydro fluoric Acid

HBr - hydro Bromic "

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydrofluoric Acid

HBr - hydro Bromic "

Ternary (oxyacids)

H + polyatomic anion

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydro fluoric Acid

HBr - hydro Bromic "

Ternary (oxyacids)

H + polyatomic anion

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydrochloric Acid

hydro - element name - ic Acid

HF - hydrofluoric Acid

HBr - hydrobromic "

Ternary (oxyacids)

H + polyatomic anion

anion name { -ate → -ic / -ite → -ous } + Acid

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydrofluoric Acid

HBr - hydro Bromic "

Ternary (oxyacids)

H + polyatomic anion

anion name { -ate → -ic, -ite → -ous } + Acid

HNO_3 - Nitric acid

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydrofluoric Acid

HBr - hydro Bromic "

Ternary (oxyacids)

H + polyatomic anion

anion name: -ate → -ic; -ite → -ous + Acid

HNO_3 - Nitric acid

H_2CO_3 - carbonic acid

Naming Acids (start w/ H)

2 types

Binary (H + other element)

HCl - Hydro chloric Acid

hydro - element name - ic Acid

HF - hydrofluoric Acid

HBr - hydro Bromic "

Ternary (oxyacids)

H + polyatomic anion

anion name { -ate → -ic / -ite → -ous } + Acid

HNO_3 - Nitric acid HNO_2 - Nitrous acid

H_2CO_3 - carbonic acid

Mol Concept

1 mol = 6.022×10^{23} "particles"

"particles"

elements → atoms

Compounds

covalent → molecule (molec)

Ionic → formula unit (f.u.)

1 mol N_2O_5 = 6.02×10^{23} molec N_2O_5

1 mol $CaCl_2$ = 6.02×10^{23} f.u. $CaCl_2$

Molar Mass

for element Molar Mass → atomic mass off per. table

$C = 12.01 \frac{g}{mol}$

Compound. Molar Mass → Total masses of each element in comp

$CO_2 \rightarrow 12 \frac{g}{mol} + 2\left(16 \frac{g}{mol}\right) = 44 \frac{g}{mol}$

$4.24_g\ HBrO_3 = \underline{\quad ? \quad}$ molec $HBrO_3$

$4.24\ g\ HBiO_3 = \underline{\quad ? \quad}$ molec $HBiO_3$

Step 1 convert g → mol

$$4.24\ g\ HBiO_3 \times \frac{1\ mol\ HBiO_3}{129\ g\ HBiO_3} = 0.0329\ mol\ HBiO_3$$

$4.24\ g\ HBrO_3 = \underline{\quad ? \quad}$ molec $HBrO_3$

Step 1 convert g → mol

$$4.24\ g\ HBrO_3 \times \frac{1\ mol\ HBrO_3}{129\ g\ HBrO_3} = 0.0329\ mol\ HBrO_3$$

Step 2 convert mol → molec

$$0.0329\ mol\ HBrO_3 \times \frac{6.\times10^{23}\ molec\ HBrO_3}{1\ mol\ HBrO_3} = 1.98\times10^{22}\ molec\ HBrO_3$$

$4.24\ g\ HBrO_3 = \underline{\quad ? \quad}$ molec $HBrO_3$

Step 1 convert g → mol

$$4.24\ g\ HBrO_3 \times \frac{1\ mol\ HBrO_3}{129\ g\ HBrO_3} = 0.0329\ mol\ HBrO_3$$

Step 2 convert mol → molec

$$0.0329\ mol\ HBrO_3 \times \frac{6.\times10^{23}\ molec\ HBrO_3}{1\ mol\ HBrO_3} = 1.98\times10^{22}\ molec\ HBrO_3$$

# of O atoms?

$$1.98\times10^{22}\ molec\ HBrO_3 \times \frac{3\ atoms\ O}{1\ molec\ HBrO_3} = 5.94\times10^{22}\ atoms\ O$$

5.60×10^{24} fu $Al(NO_3)_3$ = ? g $Al(NO_3)_3$

5.60×10^{24} fu $Al(NO_3)_3 = ?$ g $Al(NO_3)_3$

$$5.60 \times 10^{24} \text{ fu } Al(NO_3)_3 \times \frac{1 \text{ mol } Al(NO_3)_3}{6 \times 10^{23} \text{ fu } Al(NO_3)_3}$$

5.60×10^{24} fu $Al(NO_3)_3 = ?$ g $Al(NO_3)_3$

$$5.60 \times 10^{24} \text{ fu } Al(NO_3)_3 \times \frac{1 \text{ mol } Al(NO_3)_3}{6 \times 10^{23} \text{ fu } Al(NO_3)_3} \times \frac{213 \text{ g } Al(NO_3)_3}{1 \text{ mol } Al(NO_3)_3}$$

5.60×10^{24} fu $Al(NO_3)_3$ = ? g $Al(NO_3)_3$

$$5.60 \times 10^{24} \text{ fu } Al(NO_3)_3 \times \frac{1 \text{ mol } Al(NO_3)_3}{6 \times 10^{23} \text{ fu } Al(NO_3)_3} \times \frac{213 \text{ g } Al(NO_3)_3}{1 \text{ mol } Al(NO_3)_3}$$

5.60×10^{24} fu $Al(NO_3)_3$ = ? g $Al(NO_3)_3$

$$5.60 \times 10^{24} \text{ fu } Al(NO_3)_3 \times \frac{1 \text{ mol } Al(NO_3)_3}{6 \times 10^{23} \text{ fu } Al(NO_3)_3} \times \frac{213 \text{ g } Al(NO_3)_3}{1 \text{ mol } Al(NO_3)_3}$$

$$= 2.00 \times 10^{3} \text{ g } Al(NO_3)_3$$

Percent Composition

what is the % of H in H_2O?

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$$\frac{2\text{ g H}}{18\text{ g } H_2O} \times 100\% = 11.1\%\ H_2O$$

Percent Composition

what is the % of H in H_2O?

$$\frac{2\text{ g H}}{18\text{ g } H_2O} \times 100\% = 11.1\%\ H_2O$$

$$\%\text{ comp} = \frac{\text{measurement}}{\text{mass compound}} \times 100\%$$

what is % of N in "holmium(III) nitrate"?

what is % of N in "chromium(III) nitrate"?
($Cr(NO_3)_3$)

what is % of N in "chromium(III) nitrate"? ($Cr(NO_3)_3$)

$$\frac{42.0\ g\ N}{238\ g\ Cr(NO_3)_3} \times 100\% = 17.7\%\ N$$

What is the mass of Cl in 36.0 g of $BaCl_2$?

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$$\frac{71.0\ g\ Cl}{208\ g\ BaCl_2} = 0.346 \times 36.0\ g\ BaCl_2 =$$

What is the mass of Cl in 36.0 g of $BaCl_2$?

$$\frac{71.0\ g\ Cl}{208\ g\ BaCl_2} = 0.346 \times 36.0\ g\ BaCl_2 = 12.3\ g\ Cl$$

Finding empirical formulas

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empirical formula -

Finding empirical formulas

empirical formula - simplest, most Reduced formula

Finding empirical formulas

empirical formula - simplest, most Reduced formula ($CuSO_4$, CaC_2O_4 CH_2O)

Finding empirical formulas

empirical formula - simplest, most Reduced formula ($CuSO_4$, CaC_2O_4, CH_2O)

molecular formula

Finding empirical formulas

empirical formula - simplest, most Reduced formula ($CuSO_4$, CaC_2O_4, CH_2O)

molecular formula - whole # multiple of an empirical formula Based on Molar Mass

Finding empirical formulas

empirical formula - simplest, most Reduced formula ($CuSO_4$, CaC_2O_4, CH_2O)

molecular formula - whole # multiple of an empirical formula Based on Molar Mass ($C_6H_{12}O_6$, N_2O_4)

Finding empirical formulas

empirical formula - simplest, most Reduced formula ($CuSO_4$, CaC_2O_4)

CH_2O

6x

molecular formula - whole # multiple of an empirical formula Based on Molar Mass ($C_6H_{12}O_6$, N_2O_4)

a compound is 32.4% Na, 22.6% S, 45.0% O,
what is the empirical formula?

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what is the empirical formula? $Na_x S_y O_z$

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what is the empirical formula? $Na_x S_y O_z$

Step 1: Assume 100g
convert %'s → g

32.4 g Na

22.6 g S

45.0 g O

a compound is 32.4% Na, 22.6% S, 45.0% O, what is the empirical formula? $Na_x S_y O_z$

Step 1: Assume 100g & convert %'s → g

Step 2: Convert to moles

$32.4\text{ g Na} \times \frac{1\text{ mol Na}}{23.0\text{ g Na}} = 1.41\text{ mol Na}$

$22.6\text{ g S} \times \frac{1\text{ mol S}}{32.1\text{ g S}} = 0.704\text{ mol S}$

$45.0\text{ g O} \times \frac{1\text{ mol O}}{16.0\text{ g O}} = 2.81\text{ mol O}$

a compound is 32.4% Na, 22.6% S, 45.0% O, what is the empirical formula? $Na_{1.4}S_{0.7}O_{2.8}$

Step 1: Assume 100g & convert %'s → g

Step 2: Convert to moles

$32.4\text{ g Na} \times \frac{1\text{ mol Na}}{23.0\text{ g Na}} = 1.41\text{ mol Na}$

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a compound is 32.4% Na, 22.6% S, 45.0% O, what is the empirical formula? $Na_{1.4}S_{0.7}O_{2.8}$

Step 1: Assume 100g & convert %'s → g

$32.4\text{ g Na} \times \frac{1\text{ mol Na}}{23.0\text{ g Na}} = \frac{1.41\text{ mol Na}}{0.704} = 2\text{ mol Na}$

Step 2: Convert to moles

$22.6\text{ g S} \times \frac{1\text{ mol S}}{32.1\text{ g S}} = \frac{0.704\text{ mol S}}{0.704} = 1.0\text{ mol S}$

Step 3: ÷ by smallest # of moles + Plug #'s into formula

$45.0\text{ g O} \times \frac{1\text{ mol O}}{16.0\text{ g O}} = \frac{2.81\text{ mol O}}{0.704} = 4\text{ mol O}$

a compound is 32.4% Na, 22.6% S, 45.0% O, what is the empirical formula? Na_2SO_4

Step 1: Assume 100g & convert %'s → g

Step 2: Convert to moles

Step 3: ÷ by smallest # of moles & Plug #'s into formula

$32.4\text{ g Na} \times \frac{1\text{ mol Na}}{23.0\text{ g Na}} = \frac{1.41\text{ mol Na}}{0.704} = 2\text{ mol Na}$

$22.6\text{ g S} \times \frac{1\text{ mol S}}{32.1\text{ g S}} = \frac{0.704\text{ mol S}}{0.704} = 1.0\text{ mol S}$

$45.0\text{ g O} \times \frac{1\text{ mol O}}{16.0\text{ g O}} = \frac{2.81\text{ mol O}}{0.704} = 4\text{ mol O}$

a 10.15 g sample of a comp contains 4.43 g of P, and the rest O. If the molar mass of the comp is 284 $\frac{g}{mol}$, what is the molecular formula?

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4.43 g P

10.15 g − 4.43 g

→ 5.72 g O

a 10.15 g sample of a comp contains 4.43 g of P and the rest O. If the molar mass of the comp is 284 $\frac{g}{mol}$, what is the molecular formula?

$4.43\,g\,P \times \frac{1\,mol\,P}{31.0\,g\,P}$

$10.15\,g - 4.43\,g$

$\rightarrow 5.72\,g\,O \times \frac{1\,mol\,O}{16.0\,g\,O}$

a 10.15 g sample of a comp contains 4.43 g P and the rest O. If the molar mass of the comp is 284 $\frac{g}{mol}$, what is the molecular formula?

$$4.43\,g\,P \times \frac{1\,mol\,P}{31.0\,g\,P} = 0.143\,mol\,P$$

$10.15\,g - 4.43\,g \rightarrow 5.72\,g\,O$

$$5.72\,g\,O \times \frac{1\,mol\,O}{16.0\,g\,O} = 0.358\,mol\,O$$

a 10.15 g sample of a comp contains 4.43 g P and the rest O. If the molar mass of the comp is 284 $\frac{g}{mol}$, what is the molecular formula?

$$4.43\,g\,P \times \frac{1\,mol\,P}{31.0\,g\,P} = \frac{0.143\,mol\,P}{0.143} = 1\,mol\,P$$

$10.15\,g - 4.43\,g \rightarrow 5.72\,g\,O$

$$5.72\,g\,O \times \frac{1\,mol\,O}{16.0\,g\,O} = \frac{0.358\,mol\,O}{0.143} = 2.5\,mol\,O$$

a 10.15 g sample of a comp contains 4.43 g of P and the rest O. If the molar mass of the comp is 284 $\frac{g}{mol}$, what is the molecular formula?

$4.43\,g\,P \times \frac{1\,mol\,P}{31.0\,g\,P} = \frac{0.143\,mol\,P}{0.143} = 1\,mol\,P$

$PO_{2.5}$

$10.15\,g - 4.43\,g \rightarrow 5.72\,g\,O \times \frac{1\,mol\,O}{16.0\,g\,O} = \frac{0.358\,mol\,O}{0.143} = 2.5\,mol\,O$

a 10.15 g sample of a comp contains 4.43 g P and the rest O. If the molar mass of the comp is 284 $\frac{g}{mol}$, what is the molecular formula?

$4.43\,g\,P \times \frac{1\,mol\,P}{31.0\,g\,P} = \frac{0.143\,mol\,P}{0.143} = 1\,mol\,P$

$10.15\,g - 4.43\,g \rightarrow 5.72\,g\,O \times \frac{1\,mol\,O}{16.0\,g\,O} = \frac{0.358\,mol\,O}{0.143} = 2.5\,mol\,O$

$PO_{2.5} \xrightarrow[\text{can't have 0.5}]{\times 2\ \text{B/c}} P_2O_5$

a 10.15 g sample of a comp contains 4.43 g P and the rest O. If the molar mass of the comp is 284 g/mol, what is the molecular formula?

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$P_4O_{10} \leftarrow 284\ \frac{\text{g}}{\text{mol}}$ (×2)